## Space Weather Forecast

Issued on Monday, 25 December 2023 at 12:47 Local

**This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Numerous CMEs observed: Chance Minor Geomagnetic Storm G1 periods through second half of four-day forecast. Chance of Moderate-class X-ray flares throughout.**

### Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity increased notably in the past 24 hours, with a previously quiet X-ray trace punctuated by three recent Moderate-class flares: one just prior to the start at 24/1118UTC; a second at 24/1649UTC from a sunspot in the southwest; and finally one from over the southeastern solar horizon at 24/1951UTC.

There were seven sunspot regions on the facing side. The main changes in the period were a proliferating and then spreading trend in one such group near the middle of the Sun, however this appears to have stalled and has not resulted in significant flaring. The other region of note was that responsible for two recent Moderate-class flares in the southwest, with some minor pores remaining visible in advance of the main spot. There is a small 'filament' (arc of plasma) immediately west of this feature, and flaring in the sunspot group is arcing across this which has likely helped generated some of the many Coronal Mass Ejections (CMEs) seen in the past 24 hours.

The energy stored as regions of strong contrast in the magnetic field on the Earth-facing side has suffered something of a domino effect in the past 24 hours, with the Sun divesting itself of many of the filaments that had emerged in the run-up to the Christmas period, perhaps partly due to X-ray flaring across the southern end of one such filament.

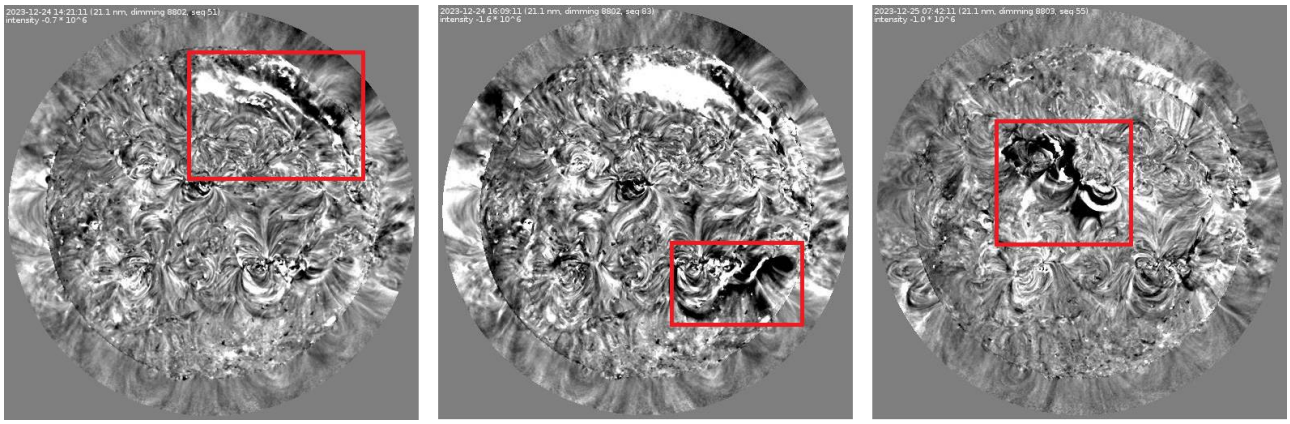

**Figure 1: Time-integrated extreme UV coronal dimmings processed by SIDC ROB, showing the three main events of note in the past 24 hours. The first two feature as glancing blow CMEs on and after 27 December, and the third will very likely add to this roster given early impressions from the latest satellite imagery and its position near the middle of the Sun.**

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The tally of CMEs is now large and carries high uncertainty for their frequency and probable inter-connectivity. The most noteworthy events are summarised as:

Firstly, a large 'filament eruption' from the northwest around the start of the current reporting period (i.e. around 24/1200UTC). This has been analysed extensively, and although it largely passes above the plane of the Earth's orbit, a glancing blow is considered possible from around the middle of the UTC day of 27 December.

Secondly, a high 'coronal dimming' visible on extreme UV imagery from the southwest around 24/1430UTC. This feature has been analysed as crossing mainly below and ahead of the Sun-Earth line around the turn of the UTC day 27 into 28 December, but again a glancing blow is considered possible.

Thirdly, a high coronal dimming around 25/0700UTC occurred near the middle of the Sun. This was not tied to any filament as such, but a CME appears to have been released. Provisionally, this is likely the most directly-aligned of any of the candidate CMEs with Earth, and early satellite imagery suggests a CME with an Earth-bound trajectory, at least in part. Further imagery is awaited for analysis.

**Solar Wind / Geomagnetic Activity:** Solar winds were slightly elevated, and while an observed weak enhancement may have originated in a weak 'coronal hole' fast wind, this is inconclusive with no clear observed source.

The solar wind speed gradually rose through the period, with the number of particles in the wind showing a similar trend. The associated magnetic field showed the opposite tendency in falling gradually, with the north-south component erratic. The net result of the above solar wind measures was for provisionally quiet geomagnetic activity.

**Energetic Particles / Solar Radiation:** No solar radiation storms were observed despite the recent Moderate-class flare activity.

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Low to moderate activity is forecast, with an ongoing chance of isolated Moderate-class X-ray flares.

**Solar Wind / Geomagnetic Activity:** There has been a glut of CMEs in recent hours, and there is now high uncertainty in the phasing of impacts during the second half of the four-day period especially. At least two have Earth-directed components, with a probable third awaiting imagery, for a full discussion please see the geomagnetic activity section.

Mainly quiet geomagnetic conditions should give way to a chance of Minor Geomagnetic Storm G1 periods on and after Wednesday 27 December as a result of CME influence. No fast winds feature.

**Energetic Particles / Solar Radiation:** There is a daily slight chance of minor solar radiation storms given any further notable flares from the southwestern sunspot region or other regions on the facing side, especially as these move into the western solar hemisphere.

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**Geomagnetic Storms:**

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 1 | 30 | 30 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Radio Blackouts - X Ray Flares:**

| X Ray Flares Probability | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | R1-R2 M Class | Yes | 50 | 50 | 50 | 50 |
| Very Active | R3 to R5 X | No | 5 | 5 | 5 | 5 |

**Solar Radiation Storms - (High Energy Protons):**

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Active | ≥ S1 | No | 5 | 5 | 5 | 5 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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